

Exhibit D – Need

Commonwealth of Massachusetts

ExhibitDNeedMA.pdf

Link to DropBox/Exhibit D:

<https://www.dropbox.com/sh/da97xghx59d3rqy/AACNNT80cLugvnN7JG3UP6Y8a?dl=0>

Factor 2 – Need / Extent of the Problem

Subfactor: Unmet Recovery Needs and Most Impacted and Distressed

Unmet Need in Target Areas and Beyond

All of MA is considered a target area for resiliency planning under this application. In addition, specific target areas for HUD funding (see Exhibit B) are Oak Bluffs on Martha's Vineyard; Shelburne Falls and Charlemont in the Deerfield River watershed; and Springfield, in Hampden County and in the Connecticut River watershed, of which the Deerfield is a tributary. Oak Bluffs experienced a destabilization of its coastal ecosystem and a breakdown of critical coastal infrastructure such as sea walls during Hurricane Sandy. Extreme precipitation during Hurricane Irene caused Shelburne Falls to be impacted by the intense river flows in the North River (tributary to the Deerfield River), which flooded the village's water supply wells and threatened to undermine the wells' stability. Charlemont was also affected by the high river flows in the Deerfield River watershed during Hurricane Irene and saw a breakdown of public infrastructure with damage to culverts and roadways (Route 2), and destabilization of the surrounding floodplain. In Springfield, hundreds of houses were destroyed and damaged, areas were de-vegetated, and other municipal and commercial holdings were damaged during five of the declared disasters. Details of target area unmet recovery needs are in Exhibit B.

Helping communities recover from disasters by addressing existing damage is the first step in addressing unmet recovery need, but we must go further. MA communities are often supported by infrastructure more than 100 years old that is in desperate need of repair and replacement and designed using outdated estimates of precipitation and flooding. Also, the natural landscape has been significantly modified. Rivers have often been channelized, placed in culverts, and completely disassociated from floodplains. This has compromised their structural integrity and fluvial geomorphology, and increased flooding and flashiness, even during smaller storm events. Fragile

coastlines have been developed upon, compromising salt marshes and dunes that provide natural habitat and protect communities from offshore wind and storm surges. Climate change poses an added risk to infrastructure, housing, environmental and economic well-being.

Unmet need across the state - in particular along the coast, in riverine corridors such as the Deerfield River watershed, and in our aging cities such as those in Hampden County - includes the need to upgrade existing crumbling infrastructure and design replacements that can accommodate future changes in climatic conditions so that residents, businesses, and their communities will be protected. We need to restore rivers and floodplains, stabilize river banks, plant trees, and conserve land to avoid the devastation to environment, infrastructure, and economy experienced by communities in Franklin County during Hurricane Irene. At that time, streamflows in the Deerfield River blew out culverts, washed out sections of Route 2, and created a transportation nightmare for low- and moderate-income families trying to go to work, buy food, and bring their children to school. Aged housing, designed using building codes that are now outdated, are in vulnerable areas and need to be replaced or rehabilitated. New or replacement housing in Springfield and Hampden County must withstand extreme winds, be energy efficient for heating and cooling, and be sited outside of flood-prone areas. We need to consider coastline development and conservation, and develop strategies such as providing protective infrastructure, incentivizing the elevation of structures and their utilities, encouraging property owners to move from high-risk locations, and conserving land that provides protection. With an opportunity to address these and other unmet needs using HUD funds, MA would jump-start local, targeted efforts at restoring life to normalcy and creating resilient neighborhoods.

Most Impacted and Distressed

Low income and vulnerable populations disproportionately suffer the effects of extreme events, are least-equipped to adapt, and rely more heavily on government for support and relief. Springfield is particularly vulnerable because of its large percentage of low-income and vulnerable populations, communities of color and immigrants, housing stock that is aged with properties that have deferred

maintenance and need repair, densely populated neighborhoods located at low elevation on the Connecticut River, small business owners that lack the resources to stay afloat after a disaster event and with limited capacity to take on recovery debt, and residents who are disproportionately impacted by health conditions. Coastal communities like the Oak Bluffs target area exist all across the MA shoreline and old crumbling infrastructure, dense populations, and historic structures make them particularly vulnerable to extreme events and coastal storms. Details of most impacted and distressed characteristics of target areas are in Exhibit B.

While MA is a wealthy state, poverty levels have increased steadily over the past few decades (http://www.massbudget.org/report_window.php?loc=From%20Poverty%20to%20Opportunity.html) across the state. 19% of the population in Hampden County, where Springfield is located, is below the poverty level, as does 21% of Suffolk County, where Boston is located. 25 years ago, nearly 20% MA residents were poor or near poor (with incomes <200% of poverty level). Today, that statistic has increased to about 25%. The state's child poverty rate rose from 9% in 1970 to 16% in 2013. This nearly doubles if children who are near poor are counted. Children of color are at particular risk for economic vulnerability; almost half of Black children and two-thirds of Hispanic children are poor. About 20% of MA families are headed by a single female; those families with at least one child age 3 years old or younger are more likely to be in low wage jobs. MA residents are also burdened by high rent as a % of their household incomes; in Hampden County, 45% of renters pay 35% or more of their household incomes on rent. The tourist-dependent areas of MA, where property values are high and wage low, are even harder hit by high rents: in Dukes County, on Martha's Vineyard where Oak Bluffs is located, that figure is 47% and in Barnstable County (Cape Cod), that figure is a staggering 50%.

Throughout MA, there are areas of poverty and other circumstances that make it nearly impossible for the population to face the challenges of disaster recovery and climate change preparedness without assistance. The MA Team includes partner Valley Opportunity Council to ensure that we work with affected communities to help them address these issues. With HUD funds to fill

gaps, we will revitalize local economies, enhance protection of the built environment, and preserve and protect public health and safety. MA's resiliency plan would enable communities such as Springfield to be robust, sustain thriving populations and businesses, and become more resilient to changing climatic conditions. Phase 2 projects supporting recovery of unmet needs will be evaluated based on an analysis of risk, cost, ability to address issues, and whether they are supported by target area communities. Projects addressing climate change will include analyses of climate change scenarios and selection of designs that are protective, cost-effective, and expected to endure over the projects' lifespans, taking into consideration their use and function. Some projects, like playgrounds and parking lots, may experience a lower risk of impact and need less protection incorporated into their designs. Projects providing critical services such as power generation, treatment plants, transportation, schools and hospitals, may need to address more extreme scenarios of future climate change to minimize risk and maintain the health and safety of communities, their populations and their built and natural environments. These solutions would be selected in consultation with the MA Team's technical experts, who are involved in developing the latest climate change science and risks.

Subfactor: Narrative on Post-Disaster Threats and Climate Change

Post-Disaster Threats and Climate Change – Observations and Predictions

MA's landscape ranges from densely populated cities to rural agricultural lands, and from very affluent neighborhoods to entire municipalities consisting of low income communities. The state has experienced an increasing frequency and intensity of extreme weather. Between 2011 and 2013, six federally declared disasters ravaged the state – coastal storms, land-bound hurricanes, snow storms, and tornadoes – and they were particularly devastating to low- and moderate-income communities, including our target areas. Along the coast, winter storms and hurricanes, sea level rise, and localized land subsidence have put our development, infrastructure, human health, and ecosystems at incredible risk. Inland, extreme precipitation, with resulting record-breaking river flows, and an upsurge in tornadoes have compromised the structural integrity of buildings, bridges and roadways; destabilized

riverine systems and infrastructure like culverts and bridges; and disrupted livelihoods and local economies. These areas, after being hit several times by different disasters, within a relatively short span of time, do not have the economic base to recover from and mitigate damages on their own.

Although FEMA investments helped significantly, the funds did not cover the full cost of repairing and restoring the vast damage. Also, the CDBG-DR funds that were allocated did help in addressing more immediate needs of the communities; again, however, the damages far exceeded the assistance received (Exhibit B). Combined with impacts from climate change, costs to recover from extreme events could be prohibitively high. The average annual cost of climate change impacts to the U.S. could reach 2.6% of the gross domestic product by 2100 (DropBox/Exhibit D/Ackerman et al 2009.pdf). The MA Team is committed to developing projects that address remaining post-disaster needs as well as threats due to climate change. Team Members have been addressing these issues through the release of EEA's 2011 Climate Change Adaptation Report , which evaluated strategies to adapt to predicted climate change (DropBox/Exhibit D/MA EEA 2011.pdf), and MA's Coordinated Climate Preparedness Initiative; Exhibit F includes some of this initiative's projects as leverage. The time is opportune to envision and create building blocks for a more resilient MA with anthropogenic and natural systems better equipped to cope with extremes and new climate change patterns.

Temperature. According to the most recent U.S. National Climate Assessment (Melillo et al, 2014 at <http://nca2014.globalchange.gov/report/regions/northeast>), increases in temperature and heat waves, will pose a challenge to MA and its people, infrastructure, ecosystems, and agriculture. The urban heat island effect will be especially magnified in the highly populated and developed Northeast. Increased temperature will result in poor air quality; heat stress and health risk to vulnerable populations such as the elderly, the young, those with respiratory conditions such as asthma, and the economically impoverished; failure of a key lifeline such as electricity, and; greater infestation of pests and occurrence of vector borne diseases. MA has temperature records dating back almost 200 years. Since 1970, average temperatures have increased nearly 0.5°F per decade, # of days above 90°F nearly

doubled, and snowpack has decreased. Winter temperatures increased faster than average temperatures. By 2100, MA is predicted to have 30-60 days with temperatures greater than 90°F and an increase of 5-10°F in average temperature (DropBox/Exhibit D/Frumhoff et al 2006.pdf, Frumhoff et al 2007.pdf). Projected extremes in temperature will place a disproportionate burden on low- and moderate-income populations; MA needs projects that address rising temperatures and can lead to solutions for low- and moderate-income populations that are not able to afford air cooling, especially those residing in urban areas where the heat island effect is predicted to be most profound.

Precipitation. According to the most recent U.S. National Climate Assessment (Melillo et al., 2014), coastal and inland flooding, and intense precipitation events will also pose an increasing challenge to the State. Impacts could include decreased snow cover, resulting in lower peak spring flows and negative impacts to water supplies and winter recreation, and could also include greater runoff and associated stormwater issues including impacts to water quality, increased flooding and impacts to structures and public health. Patterns of precipitation amount, frequency, and timing are already changing. Data recorded by the US Historical Climatology Network indicates that precipitation in the Northeast has increased 5-10% since 1900. In the past few decades, more precipitation has fallen during winter as rain (DropBox/Exhibit D/Frumhoff et al 2006.pdf, Frumhoff et al 2007.pdf, Hayhoe et al 2006.pdf, Keim et al 2005.pdf). In MA, except Cape Cod, the most recent 30-year normal precipitation is the highest since records started in 1838 (DropBox/Exhibit D/MA Water Resources Commission 2008.pdf). Over the past 50 years, average precipitation increased by 3.92 mm/year. Extreme precipitation in northern coastal New England (including MA) increased since the 1970s (DropBox/Exhibit D/Douglas and Fairbank 2011.pdf). In the last 10 years alone, increased numbers of hurricanes and storms have repeatedly brought record rains and floods with the worst recorded floods since the 1938 Hurricane, and 8 of 30 long-term USGS streamgages breaking records for peak flow.

Precipitation patterns are predicted to include higher-intensity events, increased winter precipitation mostly in the form of rain, and more droughts which could profoundly impact our

infrastructure, businesses, public health, water supplies, recreation, and ecosystems. Even under current climatic conditions, impacts from extreme events are costly. Flooding of the MBTA subway system in Boston in 1996 resulted in more than \$92 million in damages (DropBox/Exhibit D/Ruth et al 2007.pdf). Extreme precipitation can overburden urban stormwater and combined sewage systems, causing flooding and water quality violations in waters near our low- and moderate-income populations, such as the Springfield target area. It also increases runoff that pollutes beaches and closes shellfish beds, threatening the attractiveness of MA as a tourist destination and shutting down food supplies for the local population in places such as the coastal Oak Bluffs target area. The Shelburne Falls target area's water supply was impacted by riverine flooding and scouring, while culverts and important roadways were washed out in Charlemont by the intense precipitation of Hurricane Irene.

Sea Level Rise and Coastal Surge. According to the IPCC (Fifth Assessment, 2013 at <https://www.ipcc.ch/report/ar5/wg1/>), the rate of sea level rise since the mid 19th century exceeded the mean rate during the previous two millennia. Between 1901 and 2010, sea level rose by 0.62 feet. This trend is expected to continue at an increasing rate over this century. Global projections for the US (Melillo et al., 2014 and DropBox/Exhibit D/Parris et al 2012.pdf) predict an increase of up to 6.6 feet by 2100 in the Northeast. More locally, MA's 1,500 miles of coastline faces a substantial rate of sea level rise and erosion, and is naturally subsiding. Our region is identified as the "Northeast Hotspot" (DropBox/Exhibit D/Sallenger et al 2012.pdf). In the past 40-60 years, sea level rose 3-4 times faster than it did globally and relative sea level in MA rose 9" from 1921 to 2006. This trend is predicted to continue at an increasing rate. Sea level in MA rise could be 6.6' by 2100 (DropBox/ Exhibit D/Sallenger et al 2012.pdf) as sea surface temperatures are predicted to increase 8°F and coastal areas are expected to experience greater storm surges. Superimposing storm surges onto increased sea levels further increases vulnerability of low-lying coastal areas, subjecting them to extensive flood damage.

Boston is predicted to have the 4th highest risk to asset exposure due to sea level rise. Asset exposure from a mid-century 100-year storm event is estimated to exceed \$400 billion while current

asset exposure to a 100-year storm is estimated at \$77 billion (DropBox/Exhibit D/Lenton et al 2009.pdf). With the dense population and development that exists along the coastline, and the prevalence of antiquated infrastructure, impacts from climate change will only be compounded without efforts to fortify, buffer or move structures to less vulnerable areas. Evacuation costs in MA from sea level rise and coastal surge could range between \$2 billion and \$6.5 billion, depending on the severity of the storm event (Ruth et al 2007.pdf). These costs will place a disproportionate burden on vulnerable populations including low- and moderate-income areas such as our target areas, elders living on fixed incomes, and workers who cannot access alternative housing or transportation during disasters. In addition, sea level rise will have adverse effects gradually over time. For example, saltwater intrusion in coastal areas can contaminate water supplies and corrode pipes and other infrastructure. On Cape Cod, salt water is already intruding below the groundwater lens and into water supply wells, thus decreasing the quantity of freshwater available for human consumption and natural habitats.

Addressing Threats and Hazards and the Tie-Back to Unmet Recovery Needs

The MA Team will select projects that enable communities to recover from and prepare for effects of climate change, including the latest predictions on increased intensity of precipitation, sea level rise, coastal storm surge, high winds from tornadoes and hurricanes, and temperature increases. Although we will focus on low- and moderate-income areas, particularly our target areas, we are confident that in addressing the post-disaster threat and hazards in these areas, HUD funding will provide a benefit to the entire Commonwealth. Through leveraged and aligned programs, we can take the learning and approaches piloted in the target areas and adapt them across MA.

In rural riverine corridors and built-out urban areas, we will work with communities to aid recovery from past damage and manage future increased precipitation and its effects on water quality and flooding. In the Springfield, Charlemont, and Shelburne Falls target areas, and in other areas including western MA, we will seek to recharge water, prevent runoff, stabilize rivers, streams and

floodplains; and repair and replace damaged or undersized infrastructure. For example, we are currently working with urban leaders to implement green infrastructure for stormwater control in Springfield, Chicopee, and Holyoke in Hampden County in partnership with three grassroots groups.

In areas affected by Hurricane Sandy, including the Oak Bluffs target area which suffered coastal flooding, damaged roads, and eroded beaches, we will work to update and upgrade key coastal infrastructure such as sea walls and tide gates so as to better protect economic centers and residential areas located immediately behind these structures. In addition, the Commonwealth plans to prioritize and enhance natural buffering capacity by creating and restoring habitats like salt marshes, barrier beaches and other wetlands and expand green infrastructure approaches so as to establish systems that work with nature. We will develop new tools to engage the public in discussions about predictions of complicated sea level rise computer models. We will look at innovative examples of how to accommodate flood waters in an urban setting, such as Boston's Living with Water Competition.

The MA Team will also help communities develop resilience to hurricanes and tornadoes like those which recently resulted in damage to local economies, the environment, housing, and permanent public infrastructure. We will look for projects that make communities more resilient so they can withstand repeated and more severe future events. With support from the Centers for Disease Control and Prevention, DPH has been conducting a multi-year outreach effort and assessment to better understand the state of public shelters (or safe havens where residents can gather during extreme events) and communication strategies in each of the MA 351 municipalities. At the same time, DOER has been awarded grants for energy resiliency. Combining efforts like these in low- and moderate-income areas would enable us to identify where shelter is needed and then ensure that it is cost-efficiently heated and cooled through the addition of energy resilient features.

The resiliency of Massachusetts communities, environment and economies -- their ability to accommodate impacts from both existing natural hazards and future climate change -- will require planning, collaboration, and action, some of which has begun at the state, regional and local levels.